



## **Separation of peptides and interaction with forward osmosis biomimetic membranes a solution diffusion model**

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results show that these psychoactive drugs cause severe phenotypic effects on *C. elegans* when used in combination, but not individually. Additionally, the WormPharm is able to culture ample amounts of worms to conduct next generation sequencing, and we present results correlating phenotype and genotype with different combination of alcohol, caffeine and nicotine.

#### 2488-Pos Board B632

##### Separation of Peptides and Interaction with Forward Osmosis Biomimetic Membranes: A Solution Diffusion Model

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Recently, a membrane based technique, forward osmosis (FO), has gained interest with respect to the separation and purification of biomolecules. Forward osmosis relies on concentration gradients to draw water across the membrane and is as such a gentle technique compared to the traditional pressure driven membrane processes. The challenge within FO is to operate at a high water flux while maintaining a high rejection and low reverse flux of salt that may otherwise interfere with the biomolecules. By adding water-transporting aquaporin protein channels to the membrane matrix to create biomimetic membranes, selective transport of water is possible. These kinds of membranes could as such be ideal for separation of biomolecules.

In this study, a biomimetic forward osmosis membrane was tested for the separation of two peptides (416.48 Da and 691.71 Da). The membrane was found to exhibit high, but not complete, rejection rates of both peptides (>98%). It is interesting that even relatively large molecules are able to pass the otherwise dense active layer of the forward osmosis membrane. Therefore, to further understand the transport mechanisms underlying the filtration process, a custom made cell was constructed and used to model the process with filtration models. It was found that the filtration process could be modeled using the solution diffusion approach, with the diffusion coefficient being related to the radius of gyration of the peptides.

#### 2489-Pos Board B633

##### Translocation of Short Polymers through a Sieve

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We perform simulations to study the translocation of short coarse grained polymers through a sieve in a channel. We look for the effects of temperature and sieve flexibility. We find that translocation is easier at higher temperatures and when the sieve is more flexible due to the increase in polymer and sieve fluctuations.

#### 2490-Pos Board B634

##### Anomalous Ionic Conductance in Carbon Nanotube Nanochannels

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Simulations and experimental studies have reported an unusually high ionic conductance in carbon nanotube (CNT) nanochannels. The origin of this phenomenon is, however, poorly-understood: literature reports often disagree in the magnitude of the different transport mode contributions to the measured ionic current and even in what ions are actually carrying the current; moreover, results obtained with single pore measurements differ frequently from those with membranes containing billions of open CNT channels, i.e. the average CNT behavior. Toward shedding light on these phenomena, we fabricated a novel platform having vertically-aligned sub-5nm carbon nanotubes as nano-fluidic channels, the number of which can be controlled from one to billions. By employing this platform with only one or a few open CNTs, we observed giant ionic currents in CNT channels and a power-law increase of conductance with KCl concentration ( $G \sim c^n$ ,  $n=0.1-0.4$ ), a dependence that seems to be unique of CNT pores. To understand and quantify electro-osmotic flow in CNT pores (which has been proposed as the transport mode responsible for the giant ionic currents in CNTs), we investigated translocation of neutral molecules in a single CNT nanochannel with the resistive pulse technique. Furthermore, we used first-principle simulations to show that cation-CNT interactions may explain the origin of this electro-osmotic flow. Implications of our findings on the physics of electric-field-driven ionic and molecular transport in CNTs will be presented here.

#### 2491-Pos Board B635

##### Radial Dependence of DNA Translocation Velocity in a Solid-State Nanopore

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The transport of dsDNA molecules through nanopores has been extensively studied in the hope to enable low-cost and high-throughput DNA sequencing. However, the experimentally measured velocities of dsDNA translocation have a wide distribution, and this potentially can compromise the accuracy of sequencing. In order to better understand the origin of the wide distribution, I have carried out molecular dynamics simulations to study the radial dependence of the translocation velocity. Simulation results suggest a stick-slip type of motion of the dsDNA near the pore surface and a smooth translocation of the dsDNA near the pore center. When DNA is not close to the surface, the nearly constant velocity of DNA is theoretically proportional to the difference between DNA's and pore's zeta-potentials. Thus, the smooth dsDNA translocation (with a constant velocity) can be tuned by modifying the zeta-potential of a pore surface (e.g. adjusting the pH value and/or the ion concentration of an electrolyte). Therefore, by minimizing the dsDNA's interaction with the pore (e.g. chemical modification of pore's surface) as well as adjusting the zeta potential of the pore surface, the smooth transport of dsDNA with a controllable velocity can be achieved.

#### 2492-Pos Board B636

##### Nano-Confined Polymer Structures for Protein Binding

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Stimulated emission depletion lithography (STED-lithography), a further development of multiphoton polymerization (MPP) lithography, belongs to the most promising methods for 2D and 3D structuring of polymer scaffolds with structure sizes in the nanometer range. Already in the early developmental stages of STED-microscopy, it was pointed out that a nano-confined effective point-spread function (PSF) can be applied to spatially confine photo-chemical reactions to sub-diffraction volumes. In optical STED-lithography, one laser pulse excites photo-initiators for radical polymerization and a second donut-shaped laser beam locally inhibits these starter molecules in the outer rim of the PSF. This confinement of the excitation volume leads to a restriction of the size of the polymerized structures. Such a STED-based approach facilitates the creation of structures with sizes below the limits of conventional MPP. Currently, feature sizes as small as 55 nm and a resolution of 120 nm of adjacent lines can be achieved.

We use stimulated emission depletion (STED) lithography for the assembly of polymeric structures down to several nanometers in any desired geometry. Protein adhesive photoresists allow manufacturing of nano-confined, protein functionalized structures. The structures show good biocompatibility and allow an easy biofunctionalization with proteins down to a single protein level. Furthermore, we use STED-lithography to create 3D compound structures of different acrylate polymers with distinct properties. A  $\mu\text{m}$ -sized protein repellent scaffold consists of multi-photon lithography (MPP) fabricated features, carrying STED-lithography written sub-100 nm protein-binding sites.

Combining STED lithography with fluorescence microscopy allows us to produce well characterized, biocompatible structures, applicable to biological assays.

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##### Self-Assisted Optothermal Trapping of Gold Nanorods Under Two-Photon Excitation

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We report self-assisted optothermal trapping and patterning of gold nanorods (GNRs) on glass surfaces with a femtosecond laser. We show that GNRs are not only the trapping targets, but also can induce convective flows that drive more particles toward the trap. The trapping phenomenon is the net result of thermophoresis and convective flow caused by localized heating, which is due to the conversion of absorbed photons into heat at GNR's longitudinal surface plasmon resonance wavelength. We investigated the optothermal trapping of GNRs at the glass surface which can be obtained with laser power as low as 0.5 mW at 840 nm. The attraction of particles toward the central hot spot can be larger than the typical field of view, e.g. attraction toward the trap was observed from a range of  $210 \mu\text{m} \times 210 \mu\text{m}$ . By moving the laser focus away from the glass surface, at certain distances, ring patterns of GNRs on the glass surface can be obtained visualizing the regions of flow. These patterns could be